Computer Communication
EDA343, DIT 420

Time and Place: Friday 20 December 2013, 14.00-18.00 H

Course Responsible: Marina Papatriantafilou (Tel: 772 5413 -in case of need 0768-563132)

Allowed material:

- English-X (X can be French, German, Spanish, Swedish, etc) dictionary
- *No other books, no notes, no calculators, no electronic devices.*

Grading:

CTH: 3: 30-40 p, 4: 41-50 p, 5: 51-60 p

GU: Godkänd 30-50, Väl godkänd 51-60 p

Instructions

- **Write clearly your course-code (EDA343/DIT420)**
- **Start answering each assignment on a new page; use only one side of each sheet of paper; sort the sheets according to the question-ordering and number them.**
- Write in a **clear manner** and **motivate** (explain, justify) your answers. If it is not clear what is written for some answer, it will be considered wrong. If some answer is not explained/justified, it will get **significantly** lower marking.
- If you make any **assumptions** in answering any item, do not forget to clearly state what you assume.
- A good rule-of-thumb for the extend of detail to provide, is to include enough information/explanation so that a person, whose knowledge on computer communication is at the level of our introductory lecture, can understand.
- Please answer in English, if possible. If you have large difficulty with that (with all or some of the questions) and you think that your grade might be affected, feel-free to write in Swedish.
- Results, inspection of exam: Monday 13 January 2014, 13.00-14.00, room 5128 (EDIT building, west wing)

Good Luck !!! Lycka till !!!!

1. Overview and application-layer networking (10 p)

   (a) (3p) What is the motivation behind protocol layering? Does layering have any disadvantages? Explain your answer.

   (b) (2p) Why does TCP run only in the end systems and not in the intermediate network elements, routers and link layer switches?

   (c) (5p) A popular www-site can quickly become overwhelmed if it has only one server handling all of its requests. How is this tackled in practice? Mention two methods and describe how they work.

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Hints
a. molularity, standardization; - complexity, unnecessary redundancy, not always clean (eg NAT)
b. not needed, provides end2end service
c. CDN, torrent/type collaborative approaches, cluster-servers
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2. Reliable Data Transfer (10 p)

   (a) (2p) Describe the requirements for reliable data transfer.

   (b) (4p) Describe carefully TCP's methods for reliable data transfer.

   (c) (2p) Suppose Host A sends two TCP segments back to back to Host B over a TCP connection. The first segment has sequence number 65; the second has sequence number 92. (i) How much data is in the first segment? (ii) Suppose that the first segment is lost but the second segment arrives at B. In the acknowledgment that Host B sends to Host A, what will be the acknowledgment number?

   (d) (2p) It is generally a reasonable assumption when the sender and receiver are connected by a single wire that packets cannot be reordered within the channel. However, when the channel connecting the two is a network, packet reordering can occur. One manifestation of packet reordering is that old copies of a packet with a sequence or acknowledgment number of x can appear. With packet reordering, the channel can be thought of as essentially buffering packets and spontaneously emitting these packets at any point in the future. What care can be taken to guard against such duplicates?

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Hints:
a. in-order, error-free, no duplicate delivery
b. ack-based, pipelined, dynamic sliding window, ack/retransmission policies
(cf book; extensive reply needed)
c. content = diff bewteen the 2 in bytes; second ack = same as first, due to missing segment
d. large seq#range, start with random #, also TTL in network layer
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3. Congestion control and multimedia-related topics (10p)

   (a) (2p) Suppose two TCP connections are present over some bottleneck link of rate R bps. Both connections have a huge file to send (in the same direction over the bottleneck link). The transmissions of the files start at the same time. What transmission rate would TCP like to give to each of the connections?

   (b) (2p) Both congestion control and flow control in TCP limit the sender's sending rate. Then how are they different?

   (c) (3p) Why is TCP congestion control often referred to as an additive- increase, multiplicative decrease (AIMD) form of congestion control?

   (d) (3p) Are TCP's methods for reliable data transfer and congestion control helpful for applications that are sensitive to jitter? What do they imply? Explain carefully your answer. Discuss the receiving rates of data, including what is required and what is expected by TCP.

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HINTS
a- TCP aims at fair share, so approx half the available
b- care for receiver's capacity vs care for network capacity
(either can be a bottleneck, hence  adjust sending rate to min implied)
c- after slow start, increase in cong-win is + 1 segment, decrease if half the window
d - TCp implies jitter (due to cing-control + ack-based flow control);
media apps need rather constant rate, hence, use more buffering
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4. Network core and routing (10 p)

   (a) (5p) Consider an ISP that has an address block 122.211.0.0/16 and a customer C that needs maximum 6 host addresses. (i) Propose a possible allocation of address space by the ISP for C in the xxx.xxx.xxx.xxx/yy format. (ii) List the subnet mask and the addresses in this space in both dotted decimal and binary formats. Explain your answers and calculations carefully.

   (b) (3p) Why are different inter- AS and intra- AS protocols used in the Internet?

   (c) (2p) Suppose that the links and routers in the network never fail and that routing paths used between all source-destination pairs remains constant. In this scenario, does a VC or datagram architecture have more control traffic overhead? Why?

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Hints:
a. similar done in class, cf slides/notes on IP and addressing
b. in AS: care for efficiency, among AS: case also for policy; also scale is decisive
c. the outcome in terms of route is the same, hence argue about
init VC cost vs cost for having extra header info in datagram; also length of session
plays a role
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5. Data Link Layer and Wireless (10p)

   (a) (2p) Why does collision occur in CSMA, if all nodes perform carrier sensing before transmission?

   (b) (4 pt) Consider the operation of a learning switch in the context of a network in which 6 nodes labeled A through F are star connected into an Ethernet switch. Suppose that (i) B sends a frame to E, (ii) E replies with a frame to B, (iii) A sends a frame to B, (iv) B replies with a frame to A. The switch table is initially empty. Show the state of the table before and after each of these events. For each of these events, identify the link(s) on which the transmitted frame will be forwarded and justify your answers.

   (c) (4 pt) (i) Describe the RTS-CTS transmission technique. Draw a figure that will illustrate your explanation. (ii) What are the two main purposes of a CTS frame? (iii) Suppose the IEEE 802.11 RTS and CTS frames were as long as the standard DATA and ACK frames. Would there be any advantage to using the CTS and RTS frames? Why or why not?

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HINTS
a. due to propagation delay
b. similar done in class, cf slides/notes link-layer, switches
c. in book, wireless chapter; if long RTS/CTS frames, the problem is the same as the original
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6. Performance, delays, security issues (10 p)

   (a) (6p) Suppose within your Web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS lookup is necessary to obtain the IP address. Suppose that n DNS servers are visited before your host receives the IP address from DNS; this incurs an RTT of D1 per DNS. Further suppose that the Web page associated with the link contains m very small objects. Suppose the HTTP running is nonpersistent and let RTT D2 denote the RTT between the local host and the server for each object. Assuming zero transmission time of each object, how much time elapses from when the client clicks on the link until the client receives all the objects? Consider (i) Nonpersistent HTTP with no parallel TCP connections. (ii) Nonpersistent HTTP with the browser configured for m parallel connections? (iii) Persistent HTTP.

(b) (2p) Considering that an encryption technique itself is known, i.e. published, standardized, and available to everyone, even a potential intruder: where does the security of an encryption technique come from?

(c) (2p) In what way does a hash provide a better message integrity check than a checksum such as the Internet checksum)?

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Hints:
a. done in class, cf exercises notes
b. secret keys; need extremely long time to compute
c. good hash function => computationally hard to modify payload into one with the same hash
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